

PRODUCT FEATURES

- Low-Cost IEEE 802.3af PoE Module
- 5 V, 12 V DC output voltage models
- Overload and short-circuit protection¹
- Adjustable output voltage
- Low output ripple and noise
- Miniature SMD package
- IEEE 802.3af, Class 0
- High-efficiency 1500 V DC isolated DC-DC converter
- Minimal external components required
- Infomart “design-in” assistance

PRODUCT OVERVIEW

The PEM1900 is a compact IEEE 802.3af compliant Power over Ethernet (PoE) Powered Device (PD) module. Its low-cost design requires only input bridge diodes and an output capacitor to implement a complete PoE solution.

With an ultra-compact size of 22 mm × 14 mm (0.87 in × 0.55 in), the module occupies just 308 mm² (0.478 sq. in) of PCB area, making it ideal for compact, next-generation devices such as IoT products, IP phones, IP cameras, security and access-control systems, sensors, routers, and network access points.

The PEM1900 includes an isolated, high-efficiency DC-DC converter with built-in frequency dithering to reduce EMI (electromagnetic interference) and noise.

APPLICATION AREAS

- Security and alarm systems
- Voice over IP phones
- Access control systems
- IP Cameras
- Displays and network monitors
- Routers
- Public address systems
- Wireless access points
- Environmental control
- Telemetry
- Remote environmental monitoring
- Network access points

¹ If the maximum power is exceeded, the PEM1900 will operate in overcurrent mode and will automatically recover once the overload condition is removed. Continuous operation under this condition for more than 15 seconds may cause damage to the module.

Table of Contents

PRODUCT SELECTOR	3
INPUT CHARACTERISTICS	3
DC OUTPUT CHARACTERISTICS.....	3
ABSOLUTE MAXIMUM RATINGS	3
TYPICAL INPUT CONNECTIONS	4
OUTPUT CONNECTION	4
BLOCK DIAGRAM	4
PIN CONNECTIONS	5
INPUTS.....	5
ESD AND SURGE PROTECTION.....	5
TYPICAL SYSTEM CONFIGURATION	5
POWERED DEVICE (PD) SIGNATURE	6
ISOLATION	6
FREQUENCY DITHERING FOR IMPROVED EMI	6
OUTPUT VOLTAGE ADJUSTMENT	6
THERMAL MANAGEMENT	6
POWER PLANE HEAT SINK.....	7
THERMAL CONDUCTIVE INTERFACE MATERIAL (TIM)	7
PHYSICAL PACKAGE.....	8
REFLOW LAND PATTERNS	9
HAND SOLDERING LAND PATTERNS	9
APPLICATION NOTES.....	10
ROHS, REACH AND CONFLICT MINERALS COMPLIANCE	10
REVISION HISTORY	10

Table of Figures

Figure 1 - Typical input connection diagram.....	4
Figure 2 - Output connection diagram	4
Figure 3 - Block diagram.....	4
Figure 4 - Typical system configuration.....	5
Figure 5 - Thermal performance profile at $V_{IN} = 48$ V DC	7
Figure 6 - Power plane heat sink.....	7
Figure 7 - Thermal conductive Interface Material	8
Figure 8 - Mechanical dimensions.....	8
Figure 9 - Reflow land pattern	9
Figure 10 - Hand soldering land pattern	9

PRODUCT SELECTOR

Part Number	Marking	Nominal Output ² (Volts DC)	Efficiency ³ (%)	Output Power ⁴ (W)		Maximum Output Power ⁴ (W)
				70 °C	70 °C ⁵	
PEM1905	05	5	82	7	8	10
PEM1912	12	12	86	10	11	11

INPUT CHARACTERISTICS

Parameter	Symbol	Min.	Typ.	Max.	Units
Input Voltage ⁶ (recommended)	V _{IN}	36	48	57	V DC
Under Voltage Lockout ⁶	V _{UVLO}	30		36	V DC
Input Current ⁷	I _{IN}		300	350	mA
Operating Temperature ⁴	T _{OP}	-20	25	70	°C
IEEE 802.3af Power Classification ⁸	Class 0				

DC OUTPUT CHARACTERISTICS

Parameter	Symbol	Min.	Typ. ³	Max.	Units
Line Regulation			0.2		%
Load Regulation			0.5		%
Output Ripple			80		mVp-p
Isolation Voltage				1500	V DC

ABSOLUTE MAXIMUM RATINGS⁹

Supply Voltage (V _{IN})	0 V – 57 V DC
Storage Temperature (T _S)	-25 °C – 100 °C
Output Voltage (V _{OUT})	0 V to controlled output voltage (operating or non-operating)

² Output voltage is within ±3% of its nominal value at T_A = 25 °C and V_{IN} = 48 V DC

³ All specifications are typical at T_A = 25 °C and V_{IN} = 48 V DC, unless otherwise noted. These values are intended as a design aid only and are indicative, not guaranteed. Output ripple is typical with output capacitor fitted as per block diagram in Figure 3.

⁴ Refer to the THERMAL MANAGEMENT Section for operating temperature details.

⁵ When used with a POWER PLANE HEAT SINK.

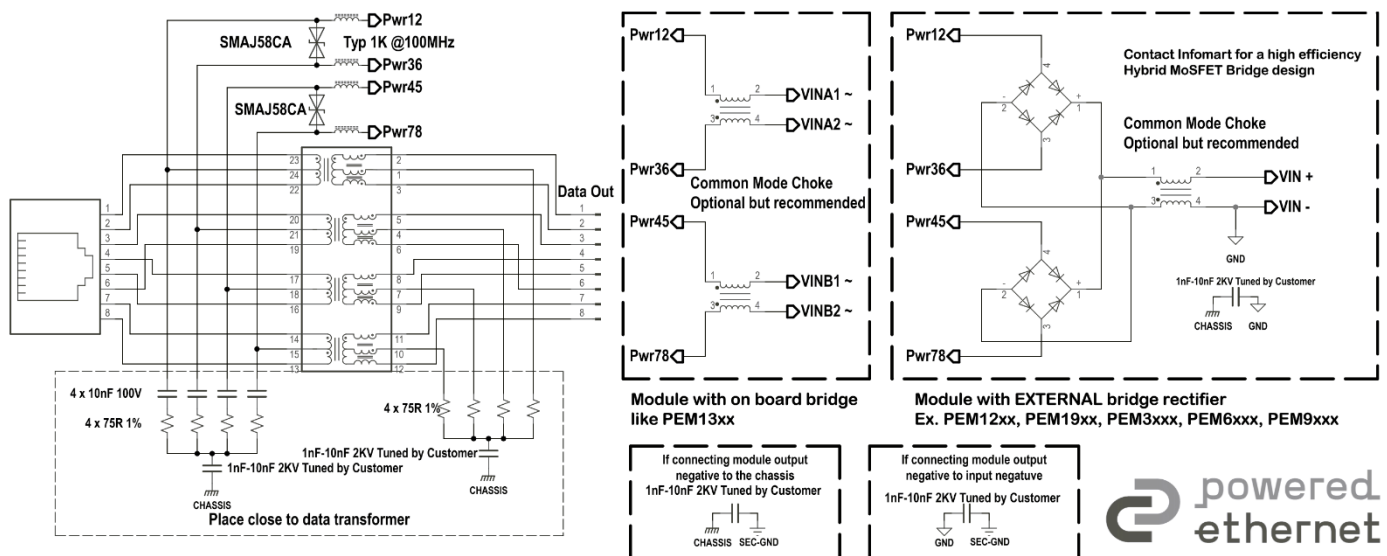
⁶ Refer to IEEE 802.3af standard.

⁷ Input current will be dependent on input voltage and will be limited by maximum output power as specified.

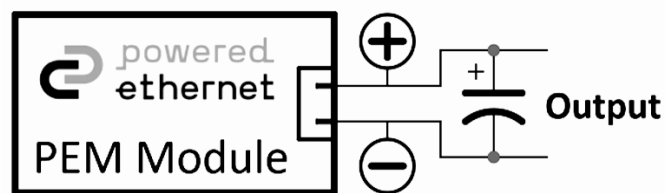
⁸ Refer to the POWERED DEVICE (PD) SIGNATURE Section for more details.

⁹ Exceeding the absolute maximum ratings may cause permanent damage to the product. Functional operation under these conditions is not implied. These ratings assume free airflow.

TYPICAL INPUT CONNECTIONS

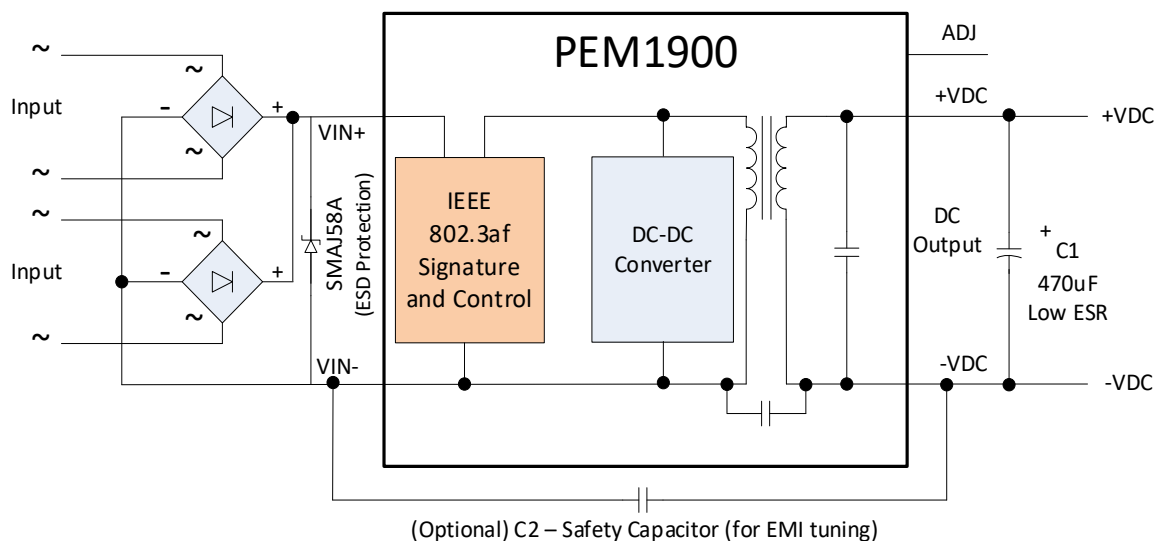


OUTPUT CONNECTION



470uF 16V or 35V output voltage dependent

BLOCK DIAGRAM



PIN CONNECTIONS

PINS	
1	+VDC. This pin provides the regulated output from the DC-DC converter.
2	-VDC. The ground return for +VDC output.
3	OADJ. The output voltage can be adjusted from its nominal value, by connecting an external resistor from this pin to either the +VDC pin or -VDC pin. For more details, refer to the <i>OUTPUT VOLTAGE ADJUSTMENT</i> Section.
4	VIN+. This pin connects to the positive (+) output of the input bridge rectifiers.
5	VIN-. This pin connects to the negative (-) output of the input bridge rectifiers.
To maintain isolation integrity, always connect respective input and output poles only via X or Y safety capacitors. System designers should maintain isolation integrity.	

INPUTS

The PEM1900 is compatible with any IEEE 802.3af-compliant Power Sourcing Equipment (PSE). It supports both PoE power injection modes: data/signal pairs (Mode A) and spare pairs (Mode B), as shown in *Figure 4*. As specified in IEEE 802.3af, the PSE supplies power using either Mode A or Mode B, not both at the same time. 4-pair PoE operation is not supported by this module. Refer to the IEEE 802.3af standard for more information.

The PEM1900 requires external input bridge rectifiers for input polarity protection and allows the system designer to select and optimise the type and cost.

ESD AND SURGE PROTECTION

The system designer must provide ESD and surge protection at the PEM1900 input, such as a TVS diode (e.g., SMAJ58A unidirectional or SMAJ58CA bidirectional).

TYPICAL SYSTEM CONFIGURATION

In Mode A (Signal Pair injection), the signal lines carry both data and power. In Mode B (Spare Pair injection), the signal pair carries only data, and the spare pair carries power.

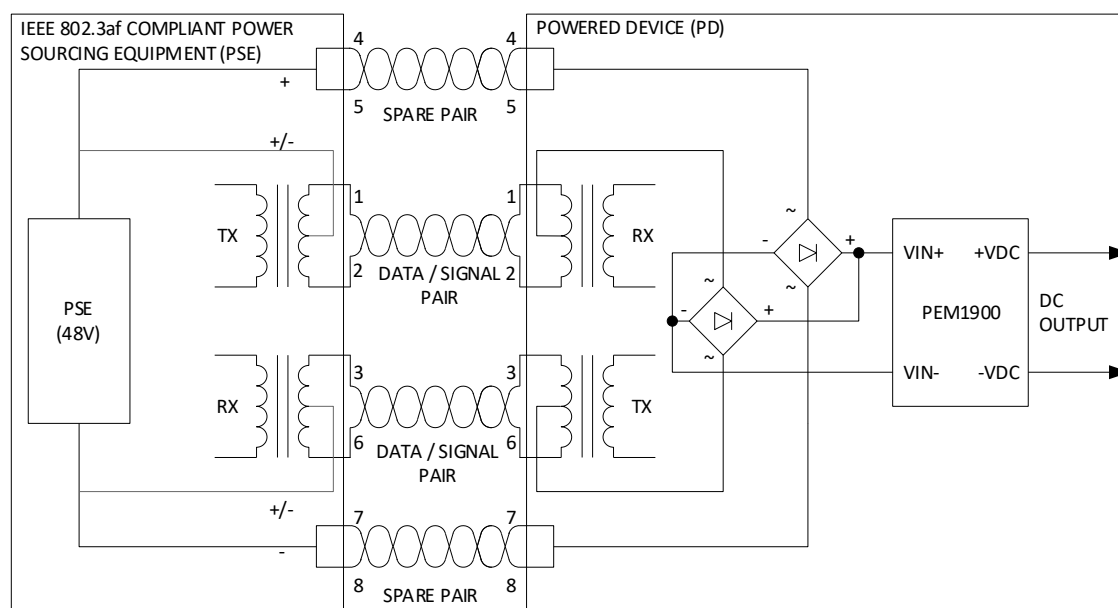


Figure 4 - Typical system configuration

POWERED DEVICE (PD) SIGNATURE

The PEM1900 presents a Powered Device (PD) Class 0 signature when connected to an IEEE 802.3af compliant PSE and when requested. We recommend use of a Cat 6 or higher grade of Ethernet cable.

ISOLATION

The PEM1900 provides 1500 V DC isolation between input and output. The system designer shall ensure that all circuitry and connections external to the module are designed and implemented to maintain compliance of the final PoE-powered device (PD) with the applicable safety standards.

The “keep-out area” shown in *Figure 6* defines the location and size of the electrical isolation barrier. To ensure compliance with the isolation requirements, this area must be kept clear of PCB tracks (traces) and planes on the base PCB on which the PEM1900 is mounted.

FREQUENCY DITHERING FOR IMPROVED EMI

The PEM1900 series includes a frequency dithering (frequency hopping) which helps reduce certain EMI emissions.

OUTPUT VOLTAGE ADJUSTMENT

The PEM1900 series has an OADJ pin that allows the output voltage to be increased or decreased from its nominal value by connecting a 1/16 W or higher, $\pm 1\%$ tolerance resistor between the OADJ pin and either the +VDC or -VDC pin, as shown in *Table 1*. Use only one connection at a time, either OADJ to +VDC or OADJ to -VDC. Do not adjust output voltage beyond $\pm 10\%$ nominal value. The estimated resistance values for voltage adjustment are provided below. Customers should fine-tune the resistance value as required. Please [contact Infomart technical support](#) for more details or specific resistor values.

PEM1905			PEM1912		
Output Voltage	OADJ to +VDC	OADJ to -VDC	Output Voltage	OADJ to +VDC	OADJ to -VDC
4.6 V	20.52 k Ω		11 V	121 k Ω	
4.8 V	46.4 k Ω		11.5 V	249 k Ω	
5 V	DNP	DNP	12 V	DNP	DNP
5.2 V		45.3 k Ω	12.5 V		82 k Ω
5.4 V		23.2 k Ω	13 V		39.2 k Ω

Table 1 - Output voltage adjustment

THERMAL MANAGEMENT

As with any power component, the PEM1900 modules generate heat. The system designer is urged to provide adequate ventilation and airflow. The amount of heat generated by the PEM1900 depends on the output load it drives. The maximum ambient operating temperature is 70 °C. *Figure 5* shows typical thermal performance at $V_{IN} = 48$ V DC. Thermal performance can be improved by applying forced airflow over the module or by using techniques described below.

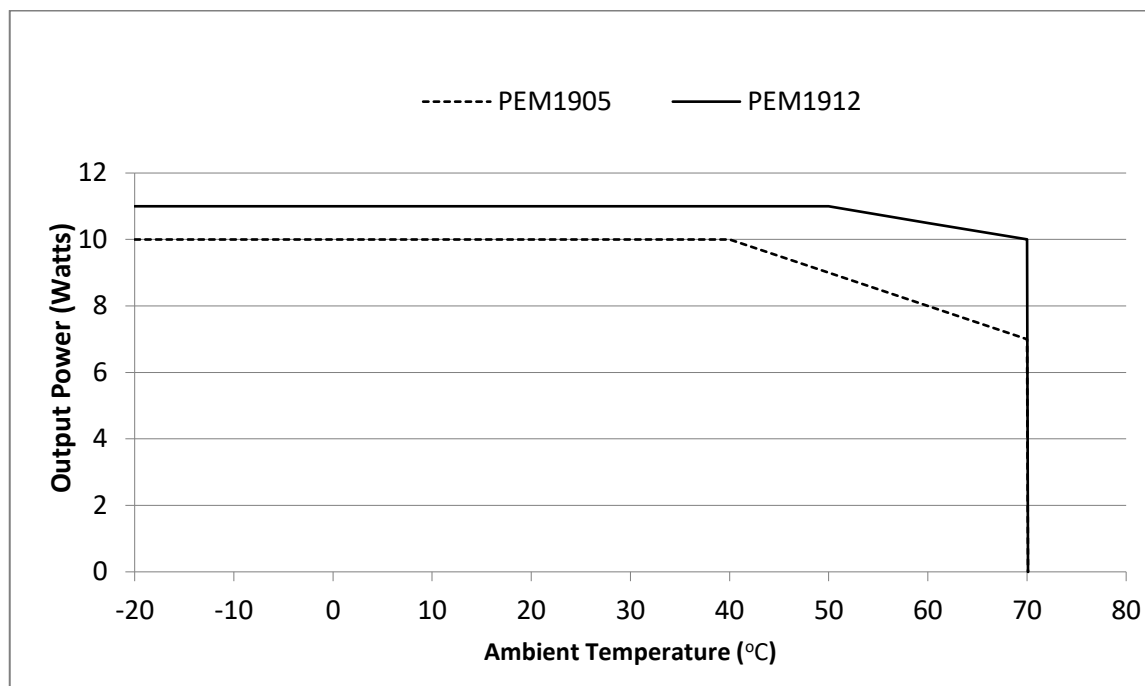


Figure 5 - Thermal performance profile at $V_{IN} = 48 \text{ V DC}$

POWER PLANE HEAT SINK

A power-plane heat sink on the motherboard provides a relatively simple method of drawing heat away from the PEM1900 through the input and output pins ($-V_{DC}$ and $+V_{DC}$). These pins connect to the PCB heat-sink area on the motherboard. **It is important to maintain electrical isolation between the pins.**

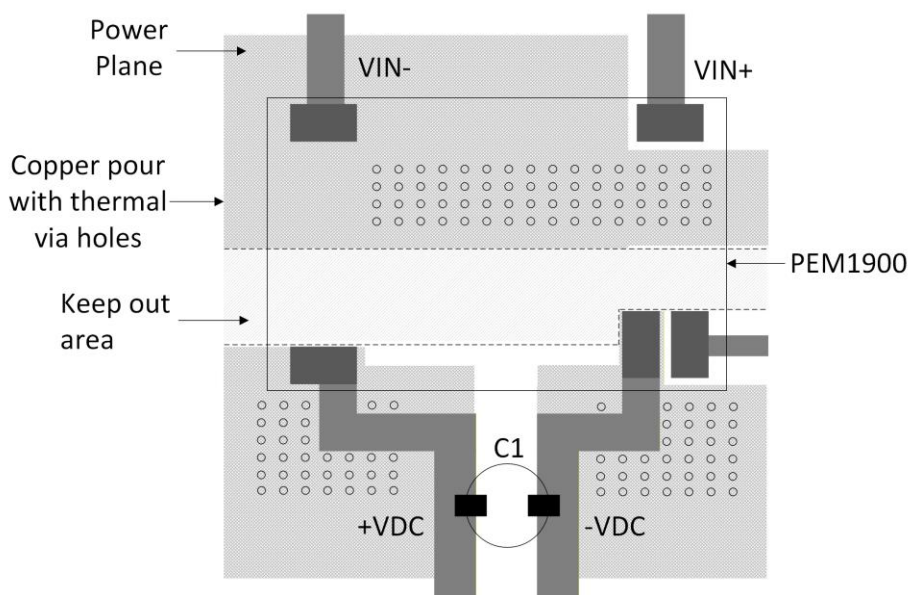


Figure 6 - Power plane heat sink

THERMAL CONDUCTIVE INTERFACE MATERIAL (TIM)

To improve heat transfer, the system designer may use a TIM, such as a thermal gap filler or thermal paste, between the module and the application motherboard, as shown in *Figure 7*. A TIM with a thermal conductivity of $1.5 \text{ W/m}\cdot\text{K}$ or greater is recommended. Care shall be taken to maintain the required electrical safety isolation between the module and the application motherboard.

Examples of suitable TIM include thermal gap fillers and putties from manufacturers such as Laird (T Putty and T Flex series), Momentive (SILCOOL), Henkel/Bergquist (Gap Pad and Gap Filler series), Parker Chomerics (THERM-A-GAP), and Fujipoly or Shin-Etsu thermal interface compounds. These examples are provided for reference only and do not constitute an endorsement of any particular product or manufacturer.

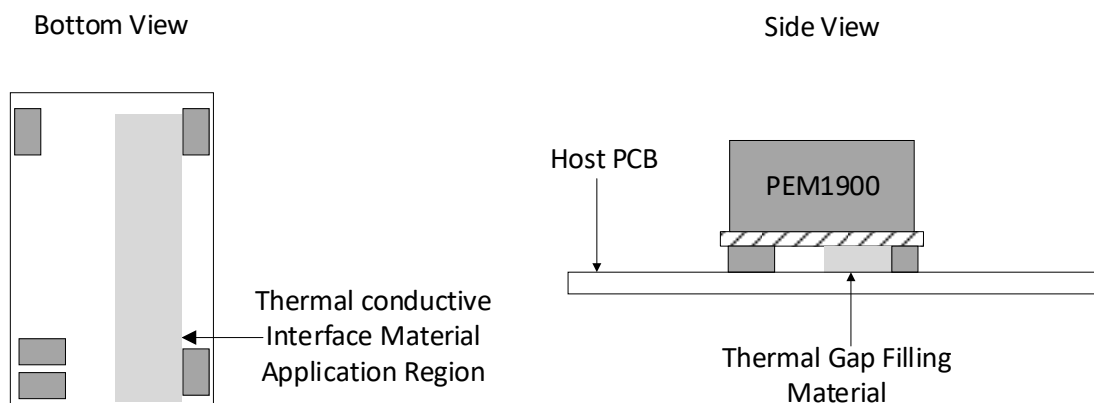


Figure 7 - Thermal conductive Interface Material

PHYSICAL PACKAGE

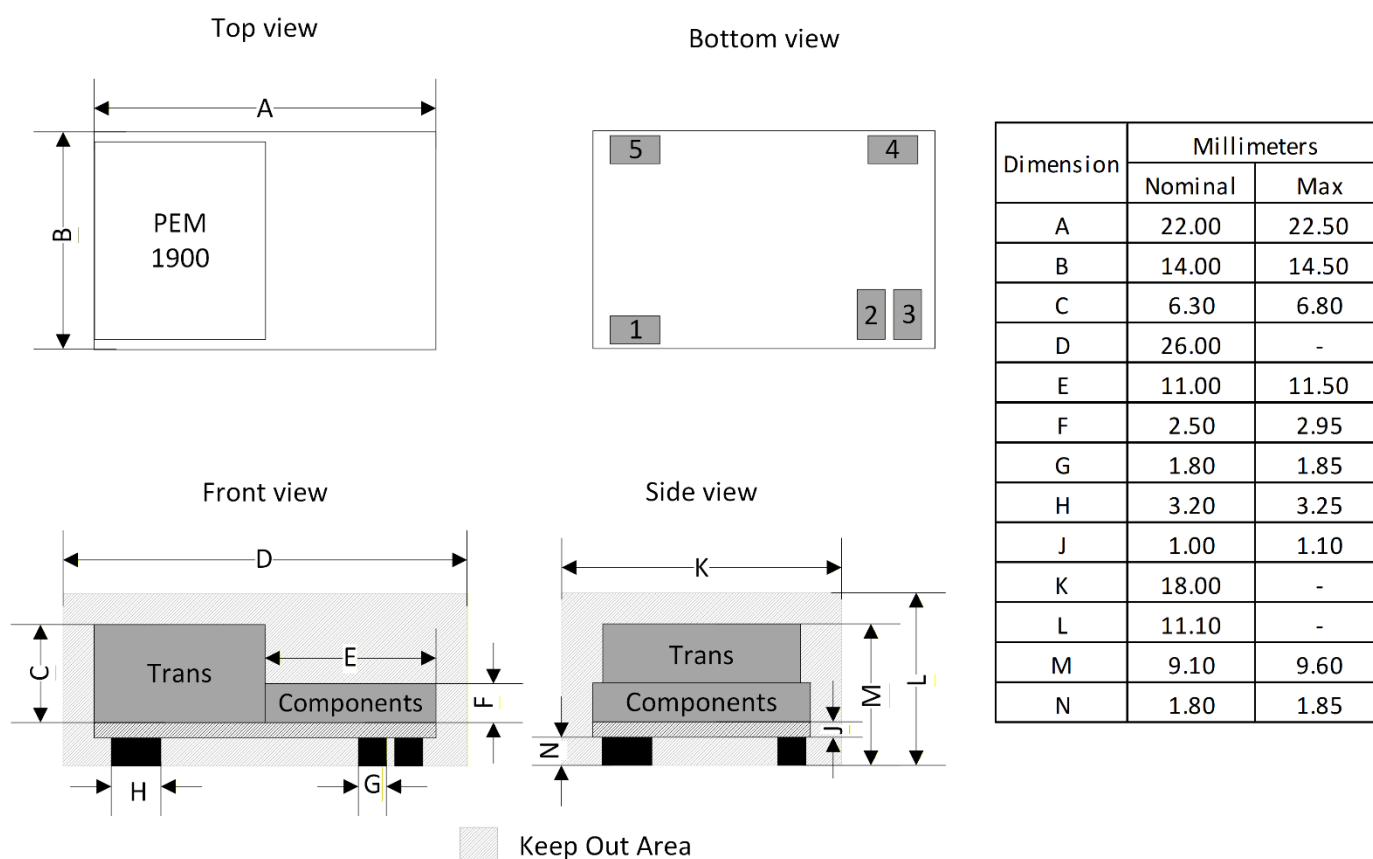


Figure 8 - Mechanical dimensions

REFLOW LAND PATTERNS

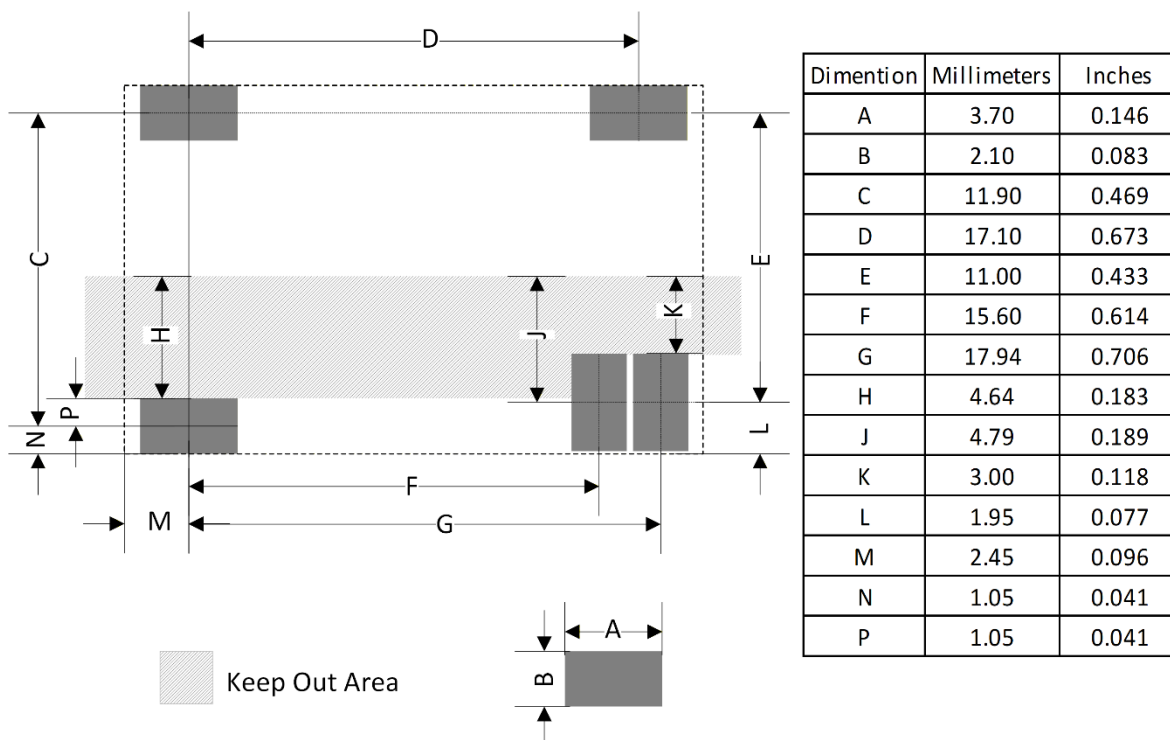


Figure 9 - Reflow land pattern

HAND SOLDERING LAND PATTERNS

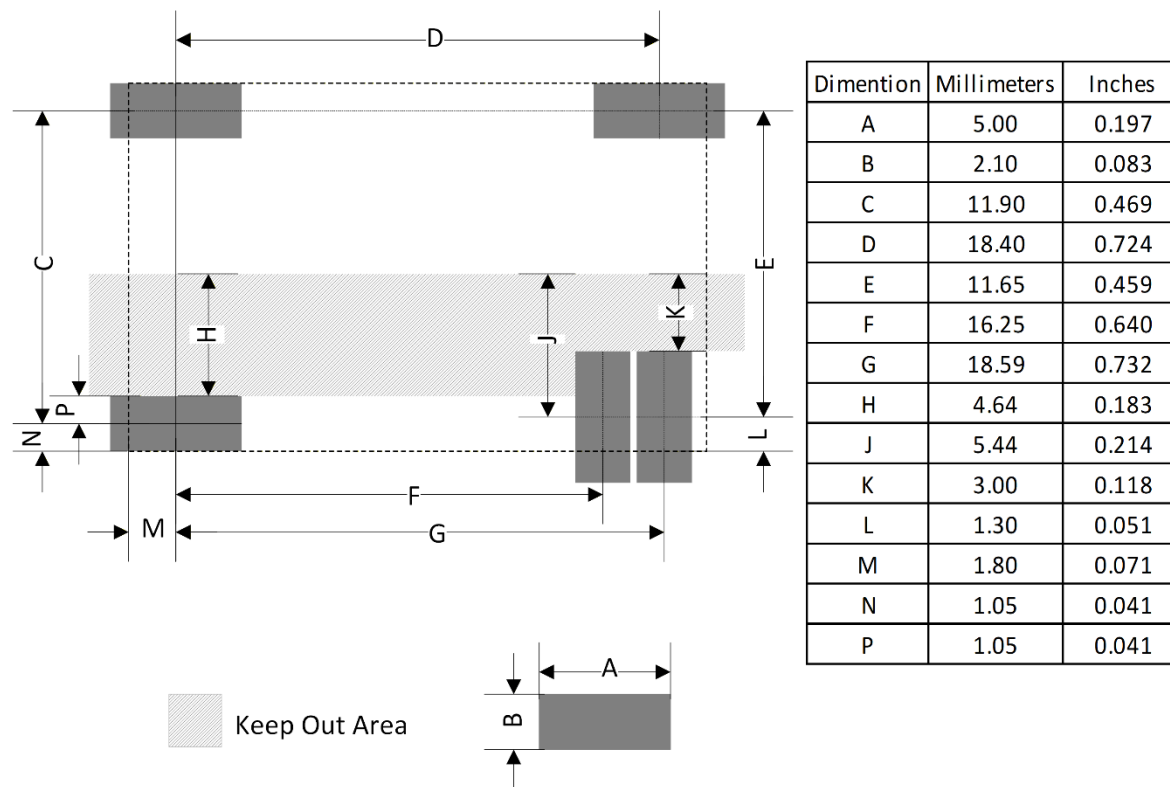


Figure 10 - Hand soldering land pattern

APPLICATION NOTES

Power over Ethernet (PoE) is a technology for wired Ethernet, which is the most widely deployed local area network technology in use today. PoE allows the electrical power required for the operation of each end device to be carried over data cables along with the data, rather than through separate power cords. This minimizes the number of wires needed to install a network, resulting in lower cost, reduced downtime, easier maintenance, and greater installation flexibility.

RoHS, REACH and CONFLICT MINERALS COMPLIANCE

RoHS, REACH and Conflict Minerals Compliance details are available on our website www.poweredethernet.com.

REVISION HISTORY

REVISION NUMBER	DESCRIPTION
25GR1	New release
25JR2	Update in ISOLATION
25LR3	Update in OUTPUT VOLTAGE ADJUSTMENT
26FR4	Update in PRODUCT SELECTOR and THERMAL MANAGEMENT
26GR5	- Heading THERMAL PASTE REGION changed to THERMAL CONDUCTIVE MATERIAL - Update in PRODUCT FEATURES, PRODUCT SELECTOR, INPUT CHARACTERISTICS, DC OUTPUT CHARACTERISTICS, INPUTS, ESD AND SURGE PROTECTION, POWERED DEVICE (PD) SIGNATURE, ISOLATION, OUTPUT VOLTAGE ADJUSTMENT, THERMAL MANAGEMENT, POWER PLANE HEAT SINK, THERMAL CONDUCTIVE MATERIAL, REFLOW LAND PATTERN, HAND SOLDERING LAND PATTERN and APPLICATION NOTES.

IEEE 802.3 POWER LEVELS AND CLASSES for PoE Powered Devices

IEEE Standard	Common Name	PD Class	PD/PSE Type	Max. number of events	PD Power ¹	PSE Power ²	Wire pairs energised
802.3af	PoE	0	1	-	12.95 W	15.4 W	2
802.3af	PoE	1	1	1	3.84 W	4 W	2
802.3af	PoE	2	1	1	6.49 W	7 W	2
802.3af	PoE	3	1	1	12.95 W	15.4 W	2

¹ Min. power delivered to PD / Module input. Max. PD / Module output depends on operating conditions.

² Power delivered from the Power Sourcing Equipment (PSE) (switch or injector) at its output port.

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